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# THE WINGS OF INSECTS.

J. H. COMSTOCK AND J. G. NEEDHAM.

## CHAPTER III (*continued*).

### VIII. THE VENATION OF THE WINGS OF DIPTERA.

In the order Diptera, as in the Trichoptera, a great reduction of wing tracheæ has taken place. Owing to this fact we have not found that any light is thrown on the question of the homology of the wing-veins by a study of the tracheation of the wings of dipterous pupæ. We will, therefore, confine our attention in this place to a study of the wings of the adult.

In this order the tendency towards a cephalization of the flight function, which occurs in nearly all of the orders of winged insects, reaches its maximum development, and has resulted in the complete suppression of the hind wings as organs of flight.

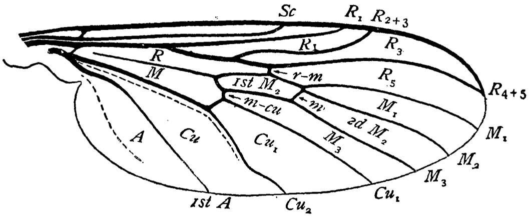

FIG. 29. — Wing of Rhyphus.

Notwithstanding this great modification of the organs of flight, the remaining pair of wings retain, in the more generalized members of the order, the primitive type of wing venation but slightly modified. So unimportant are the changes that the determination of the homologies of the wing-veins in these forms presents no difficulties.

If a wing of Rhyphus (Fig. 29) be compared with our hypothetical type (Fig. 5)[1], it will be found to correspond very closely with it, the only differences being due to a slight reduction in the number of the veins ; the radial sector is reduced to a two-branched condition, the media is only three-branched, and only one of the anal veins is well preserved.

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[1] *American Naturalist*, April, 1898, No. 376, p. 251.

Although it is an easy matter to determine the homologies of the wing-veins in a generalized form like Rhyphus, it would be exceedingly difficult, if not impossible, to do this in the case of some of the more specialized forms if they alone were studied. But when a carefully selected series of forms is examined the difficulties vanish.

We wish now to call attention to such a series for the double purpose of demonstrating the homologies of the wing-veins in the more specialized forms and of showing the value in taxonomic work of the characters presented by the wings.

It should be borne in mind that the different parts of the wing may be modified more or less independently. Although the wing acts as a whole as an organ of flight, any change in the habit of flight is likely to result in a greater modification of some one part than of others. Thus we may find that in one line of descent a certain part is greatly modified and another part remains but slightly changed from the primitive type ; while in another line of descent the opposite may be the case. It is necessary, therefore, in discussing the changes that have taken place in the venation of the wings to treat the different veins separately. We will, however, refer to only a few of the more important of these changes, as a series of figures illustrating the homologies of the wing-veins of each of the families of this order has already been published by one of us.[1]

*The reduction of the radial sector.* — In a few genera of flies the radius retains the primitive, five-branched condition ; of these the genus Protoplasa of the Tipulidæ is a good example.[2] But usually the number of the branches of this vein is reduced by a coalescence of some of the branches of the radial sector. Thus in many families the radial sector is three-branched, in others it is only two-branched, and in the gallgnats (Cecidomyiidæ) it is reduced to a simple, unbranched condition.[1]

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[1] Comstock, *Manual for the Study of Insects*, pp. 413–489.

[2] *Loc. cit.*, Fig. 504.

As this variation in the number of the branches of this vein is due to a greater or less degree of coalescence among them, it is evident that here is a character of considerable taxonomic importance, serving as it does to indicate degrees of divergence from the primitive type.

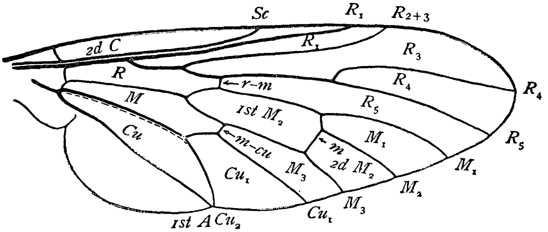

FIG. 30. — Wing of Leptis.

Not only do we find differences in degree of reduction of this vein, but differences in the method of reduction are also shown. If the wing of Leptis (Fig. 30) and of Dixa (Fig. 31) be compared it will be seen that although in each the radial sector is only three-branched, the reduction has been brought about in a different way in the two genera. In Leptis veins $R_2$ and $R_3$ coalesce; while in Dixa it is veins $R_4$ and $R_5$ that have grown together. This is a difference in kind of specialization, which indicates that the two forms belong to different lines of descent. The common progenitor of these two genera had a four-branched radial sector; in some of the descendants of this primitive form one method of reduction has taken place, while in other descendants another method has been followed.

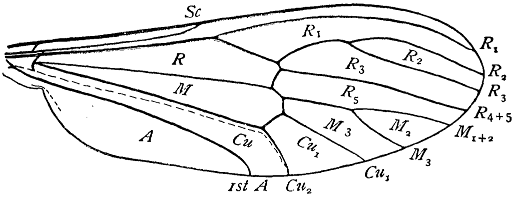

FIG. 31. — Wing of Dixa.

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[1] *Loc. cit.*, Fig. 522.

That this differentiation took place comparatively early in the history of the order is shown by the fact that in all Nematocera that have a three-branched radial sector veins $R_2$ and $R_3$ remain distinct; while in those Brachycera that have a three-branched radial sector veins $R_4$ and $R_5$ are separate.

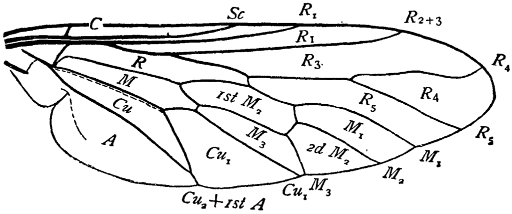

FIG. 32. — Wing of Thereva.

*The coalescence of veins $M_3$ and $Cu_1$.* — One of the most characteristic methods of specialization exhibited by the Diptera is the coalescence of veins from the margin of the wing towards the base. This method of coalescence may occur between any two adjacent veins, and sometimes occurs in two or three different regions of the same wing. The most striking modifications in the courses of the wing-veins have been brought about in this way. Let us examine a series illustrating different degrees of coalescence of veins $M_3$ and $Cu_1$.

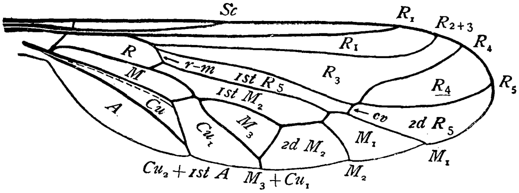

FIG. 33. — Wing of Eulonchus.

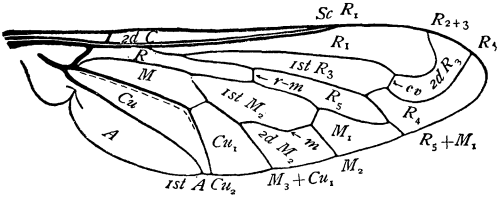

FIG. 34. — Wing of Pantarbes.

In Rhyphus (Fig. 29) these two veins retain their primitive position, extending nearly parallel and ending remote from each other at the margin of the wing. In Thereva (Fig. 32) an approximation of the ends of these veins has taken place, which results in a narrowing of the outer end of cell $M_3$. In

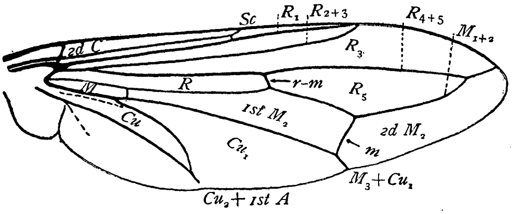

Fig. 35. — Wing of Conops.

Eulonchus (Fig. 33) the tips of the two veins coalesce, and cell $M_3$ is thus closed. In Pantarbes (Fig. 34) the two veins coalesce for the greater part of their length, and cell $M_3$ is completely obliterated.

*The coalescence of veins $Cu_2$ and 1st $A$.*—The second branch

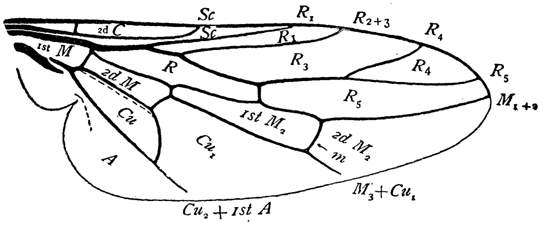

Fig. 36. — Wing of Scenopinus.

of the cubitus and the first anal vein may also coalesce in varying degrees. In Rhyphus (Fig. 29) these two veins retain their primitive position. In Leptis (Fig. 30) the tips are ap-

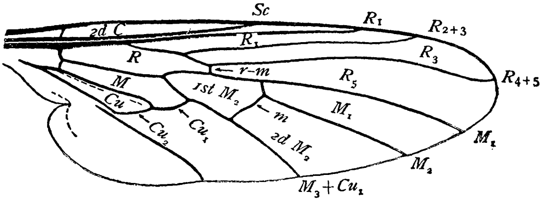

Fig. 37. — Wing of Rhamphomyia.

proximate. In Thereva (Fig. 32) the tips coalesce for a short distance. In Conops (Fig. 35) the coalescence is more striking. In Scenopinus (Fig. 36) it is carried still farther. While in Rhamphomyia (Fig. 37) it has proceeded so far that vein $Cu_2$ extends towards the base of the wing, and presents the appearance of a cross-vein.

It is not strange that the homology of the branches of the cubitus in forms like Rhamphomyia was not understood until the method of study used here was employed, but now there is no doubt regarding it.

The independent specialization of different parts of the wing can be seen by comparing members of the two series given above. Compare, for example, Thereva (Fig. 32) with Pantarbes (Fig. 34). If one were to consider only the degree of coalescence of veins $Cu_2$ and *1st A*, Thereva would be considered the more highly specialized of the two genera, for in this genus these two veins coalesce for a considerable distance, while they are still distinct in Pantarbes. But if the degree of coalescence of veins $M_3$ and $Cu_1$ be considered the opposite conclusion would be reached, for in Pantarbes these veins coalesce for the greater part of their length so that cell $M_3$ is completely obliterated, while in Thereva these veins are still distinct. No better evidence could be desired for showing the impossibility of arranging animals in a natural linear series. And it is not too much to hope that an exhaustive study along these lines will serve to determine the phylogeny of the families of this order.

Entomological Laboratory,
Cornell University, April, 1898.